इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 14558 (1998): Horology - Primary batteries - Watch batteries [PGD 23: Horology]

"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

IS 14558 : 1998
ISO/DIS 14682 : 1996

भारतीय मानक

घड़ीसाज़ी — प्राथमिक बैटरियाँ — घड़ियों के लिये बैटरियाँ

Indian Standard

HOROLOGY — PRIMARY BATTERIES — WATCH BATTERIES

ICS 39.040.10; 29.220.99

© BIS 1998

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

July 1998

Price Group 6

Horology Sectional Committee, LM 23

NATIONAL FOREWORD

This Indian Standard which is identical with ISO/DIS 14682 : 1996 'Primary batteries—Watch batteries' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Horology Sectional Committee (LM 23) and approval of the Light Mechanical Engineering Division Council.

The text of ISO/DIS has been approved as suitable for publication as Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard they should be read as Indian Standard.

b) Comma (,) has been used as a decimal marker while in Indian Standards the current practice is to use a point (.) as the decimal marker.

In this adopted Standard reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standard which is to be subsitituted in its place is listed below along with its degree of equivalence for the edition indicated:

International Standard	*Indian Standard*	*Degree of Equivalence*
ISO 2859-1 : 1989	IS 2500 (Part 1) : 1992 Sampling procedures for inspection by attributes: Part 1 Sampling plans indexed by acceptable quality level (AQL) for lot- by-lot inspection	Identical

The concerned technical committee has reviewed the provisions of IEC 86-1 : 1993 and IEC 86-2 : 1993, referred in this adopted DIS and has decided that these are acceptable for use in conjunction with this standard.

Indian Standard

HOROLOGY — PRIMARY BATTERIES — WATCH BATTERIES

1 Scope

This International Standard specifies dimensions, designation, test methods and requirements for primary batteries for watches. In several cases, a choice of test methods is given. When presenting battery electrical characteristics and/or performance data, the manufacturer should specify which test method was used.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2859-1:1989, *Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection.*

IEC 86-1:1993, *Primary batteries — Part 1: General.*

IEC 86-2:1993, *Primary batteries — Part 2: Specification sheets.*

3 Definitions

For the purposes of this International Standard, the definitions given in IEC 86-1 apply.

4 Mechanical requirements

4.1 Dimensions and size codes

Dimensions and tolerances of batteries for watches shall be in accordance with figure 1 and table 1. The dimensions of the batteries shall be tested in accordance with the procedure given in 8.2.

4.2 Terminals

4.2.1 Negative contact (–)

The negative contact (dimension *m*) shall be in accordance with table 1. This is not applicable to batteries with a two-step negative contact.

4.2.2 Positive contact (+)

The cylindrical surface of the battery shall be connected with the positive terminal (see IEC 86-2).

Dimensions in millimetres

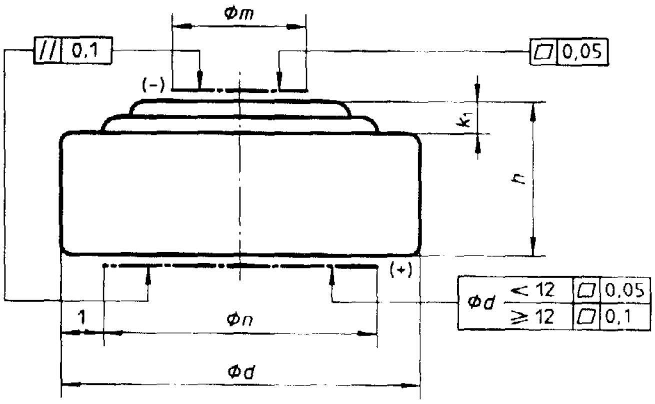


Figure 1 — Dimensional characteristics

Table 1 — Dimensions and size codes

Dimensions in millimetres

Diameter			m_{min}	**Height, *h***														
				Code [1]														
				10	12	14	16	20	21	25	26	27	30	31	32	36	42	54
				Tolerance														
Code [1]	*d*	Tol.		$^{0}_{-0,10}$	$^{0}_{-0,15}$	$^{0}_{-0,15}$	$^{0}_{-0,18}$	$^{0}_{-0,20}$	$^{0}_{-0,20}$	$^{0}_{-0,20}$	$^{0}_{-0,20}$	$^{0}_{-0,20}$	$^{0}_{-0,25}$	$^{0}_{-0,25}$	$^{0}_{-0,25}$	$^{0}_{-0,25}$	$^{0}_{-0,25}$	$^{0}_{-0,25}$
4	4,8	$^{0}_{-0,15}$					1,65		2,15									
5	5,8	$^{0}_{-0,15}$	2,6	1,05	1,25	1,45	1,65		2,15			2,70						
6	6,8	$^{0}_{-0,15}$	3,0	1,05	1,25	1,45	1,65		2,15		2,60							
7	7,9	$^{0}_{-0,15}$	3,5	1,05	1,25	1,45	1,65		2,10		2,60			3,10		3,60		
9	9,5	$^{0}_{-0,15}$	4,5	1,05	1,25	1,45	1,65	2,05				2,70				3,60		
11	11,6	$^{0}_{-0,20}$	6,0	1,05	1,25	1,45	1,65	2,05			2,60		3,05			3,60	4,20	5,40
12	12,5	$^{0}_{-0,25}$	4,0		1,20		1,60	2,00		2,50								

[1] See clause 6.

NOTE — Open boxes in the above matrix are not necessarily available for standardization due to the concept of overlapping tolerances.

Diameter			m_{min}	**Height, *h***					
				Code [1]					
				12	16	20	25	30	32
				Tolerance					
Code [1]	*d*	Tol.		$^{0}_{-0,20}$ [2]	$^{0}_{-0,20}$ [2]	$^{0}_{-0,25}$ [2]	$^{0}_{-0,30}$ [2]	$^{0}_{-0,30}$ [2]	$^{0}_{-0,30}$ [2]
16	16	$^{0}_{-0,25}$	5,0	1,20	1,60	2,00	2,50		
20	20	$^{0}_{-0,25}$	8,0	1,20	1,60	2,00	2,50		3,20
23	23	$^{0}_{-0,30}$	8,0	1,20	1,60	2,00	2,50		
24	24,5	$^{0}_{-0,30}$	8,0	1,20	1,60			3,00	

[1] See clause 6.

[2] To be reduced in the future.

NOTE — Open boxes in the above matrix are not necessarily available for standardization due to the concept of overlapping tolerances

4.3 Projection of negative terminal (k_1)

The dimension k_1 shall be as follows:

$k_1 \geqslant 0{,}02$ for $h \leqslant 1{,}65$

$k_1 \geqslant 0{,}06$ for $1{,}65 < h < 2{,}5$

$k_1 \geqslant 0{,}08$ for $h \geqslant 2{,}5$

The negative contact shall be the highest point of the battery.

4.4 Shape of negative terminal

The space requirements for batteries with a diameter less than or equal to 11,6 mm shall be contained within an angle of 45° (see figure 2).

The minimum values of a, for different values of the height h, are given in table 2.

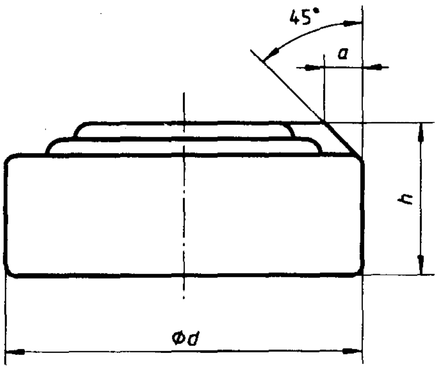


Figure 2 — Shape of negative terminal

Table 2 — Minimum security values of a

Dimensions in millimetres

h	a_{min}
$1 < h \leqslant 1{,}90$	0,20
$1{,}90 < h \leqslant 3{,}10$	0,35
$3{,}60 \leqslant h \leqslant 4{,}20$	0,70
$5{,}40 \leqslant h$	0,90

NOTE — The a_{min} requirement shall not apply to new batteries standardized after October 1992.

4.5 Mechanical pressure resistance

A force of F, in newtons, as specified in table 3, applied for 10 s through a steel ball of 1 mm diameter, at the centre of each contact area, shall not cause any deformation prejudicial to the proper functioning of the battery; i.e. after this test, the battery shall pass the tests specified in clause 8.

Table 3 — Applied force F depending on battery dimensions

Battery dimension d mm	**Force, F** N	
	$h < 3$ mm	$h \geqslant 3$ mm
< 7,9	5	10
⩾ 7,9	10	10

4.6 Deformation

The dimensions of batteries shall conform to the relevant specified dimensions at all times (new, in storage, etc.), including discharge to the defined endpoint voltage.

NOTE 1 An increase of battery height of 0,25 mm can occur in L, C, B and G systems, if discharged below this voltage.

4.7 Leakage

Fresh batteries and, if required, batteries tested in accordance with the procedure given in 8.3.6 shall be examined as stated in 8.5. The number of tolerated defects shall be agreed on between the manufacturer and customer.

5 Electrical requirements

5.1 Electrochemical system, nominal voltage, endpoint voltage and off-load voltage

The requirements concerning the electrochemical system, the nominal voltage, the endpoint voltage and the off-load voltage are given in table 4.

Table 4 — Basic electrical characteristics for typical systems

Code	Positive electrode	Electrolyte	Negative electrode	Nominal voltage	Endpoint voltage	Off-load voltage	
						max.	min.
L	Manganese dioxide	Alkali	Zinc	1,5	1,0	1,65	1,50
S	Silver oxide (Ag_2O)	Alkali	Zinc	1,55	1,2	1,63	1,57
C	Manganese dioxide	Organic	Lithium	3	2,0	3,70	3,00
B	Carbon monofluoride	Organic	Lithium	3	2,0	3,70	3,00
G	Copper oxide	Organic	Lithium	1,5	1,2	2,30	1,70

5.2 On-load voltage, internal impedance and internal resistance

On-load voltage, internal impedance and internal resistance shall be measured in accordance with the procedure given in 8.3. Limit values shall be agreed between the manufacturer and customer.

NOTE 2 Knowledge of the internal resistance alone is not sufficient for horological applications.

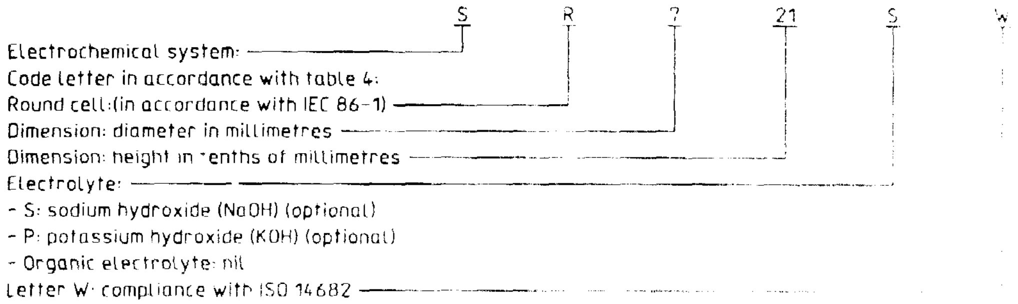
5.3 Capacity

The capacity shall be agreed between the manufacturer and customer on the basis of a continuous discharge test lasting approximately 20 to 35 days, in accordance with the procedure given in 8.3.6.

6 Designation

Watch batteries manufactured with the express purpose of complying with this International Standard should be designated by a system of coded letters and numbers as shown below. However, the letter W is used to indicate compliance with this International Standard.

EXAMPLE


S
R
7
21
S
W
Electrochemical system:
Code letter in accordance with table 4:
Round cell:(in accordance with IEC 86-1)
Dimension: diameter in millimetres
Dimension: height in tenths of millimetres
Electrolyte:
- S: sodium hydroxide (NaOH) (optional)
- P: potassium hydroxide (KOH) (optional)
- Organic electrolyte: nil
Letter W: compliance with ISO 14682

7 Marking

Batteries should be marked with the following information:

a) designation in accordance with clause 6;

b) name or trademark of the manufacturer or supplier;

c) polarity of connection component (+);

d) date or manufacture code of two symbols:

The code is composed by the last digit of the year and by a number indicating the month. October, November and December should be represented by the letters O, Y and Z respectively.

EXAMPLE

01: January 1990

9Y: November 1999

e) date by which the battery should be used can be indicated, but on the packaging only.

The marking shall not impede electrical contact.

8 Test methods

8.1 Sampling

When testing by attributes is required, the chosen sampling plan, for all methods of control and measurement specified in clause 8, shall be in accordance with the specifications of ISO 2859-1. The parameters treated individually and the values of the acceptable quality level (AQL) shall be agreed between the manufacturer and customer.

8.2 Shape and dimensions

8.2.1 Diameter and height

The diameter and height shall be checked by calibration with an accuracy sufficient to comply with the tolerance requirements stated in table 1.

Other similar control methods are admitted, provided that they are of equivalent accuracy.

8.2.2 Shape requirements

The shape of the negative contact is checked preferably by optical projection (method 1), or by an open gauge as shown in figure 3 (method 2).

The selection of method 1 or 2 shall be agreed between the manufacturer and customer.

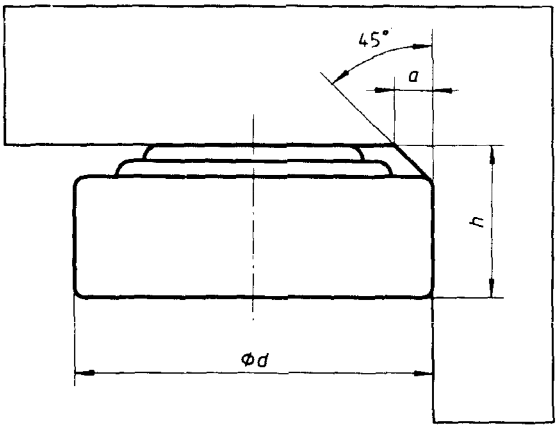


Figure 3 — Shape requirement (method 2)

8.3 Electrical characteristics

8.3.1 Equivalent circuit

The general equivalent circuit of a battery is described in 2.11 of IEC 86-1:1993.

The battery shall be modelled as a pure e.m.f. in series with a combination of capacitors and resistors which are themselves in series and in parallel, which gives non-ohmic behaviour to batteries as circuit elements.

The device characteristics shall be considered when the selection of the battery is made.

The characterization of selected batteries to meet such conditions of discharge shall be carried out by the manufacturer and customer.

In the tests proposed in the following subclauses, the battery is verified as being purely ohmic by measuring the on-load voltage U_{cf} at the end of the discharging impulse with a duration time t that is after an important attenuation of the transitory effect of the capacitive reactance (see figure 4). The time Δt necessary for the measurement shall be brief in comparison to t, and the measurement equipment shall be compatible with this criteria.

8.3.2 Equipment

The equipment used for the voltage measurements shall have the following specifications:

- accuracy: ⩽ 5 mV
- internal resistance: ⩾ 10 M Ω
- measurement time: see 8.3.1

8.3.3 Environmental conditions

Unless otherwise specified, the sample batteries shall be tested at a temperature of 20 °C ± 2 °C and a relative humidity between 45 % and 70 %.

The batteries can be exposed to occasional variations of temperature; it is therefore recommended to carry out tests at 0 °C and at − 10 °C in order to take these occasional and exceptional variations into consideration.

8.3.4 Measurement of off-load voltage, U_{co}, and on-load voltage, U_{cf}

The principles of the circuit are shown in figure 5.

8.3.4.1 First measurement: U_{co}

The switch is left open while this measurement is carried out.

8.3.4.2 Next measurement: U_{cf}

The battery being tested shall be connected to the load R_m. The switch shall be left closed for a time t in accordance with table 5.

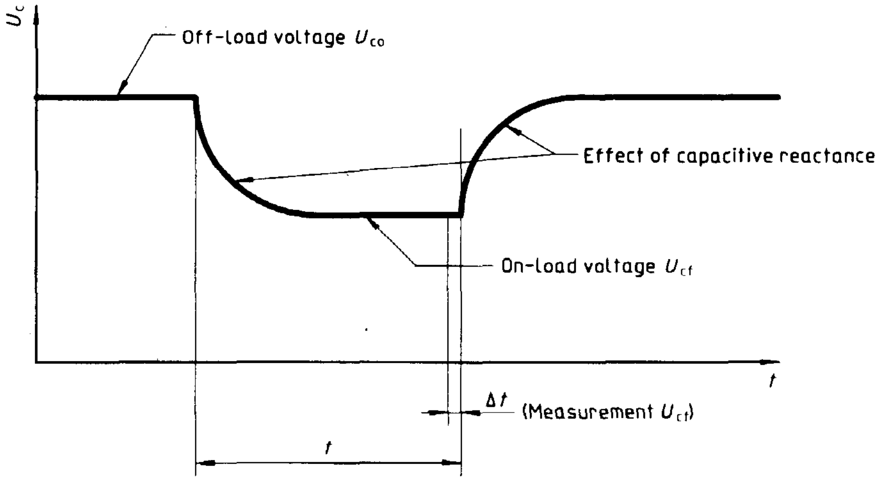


Figure 4 — Curve 1: $U_c = f(t)$

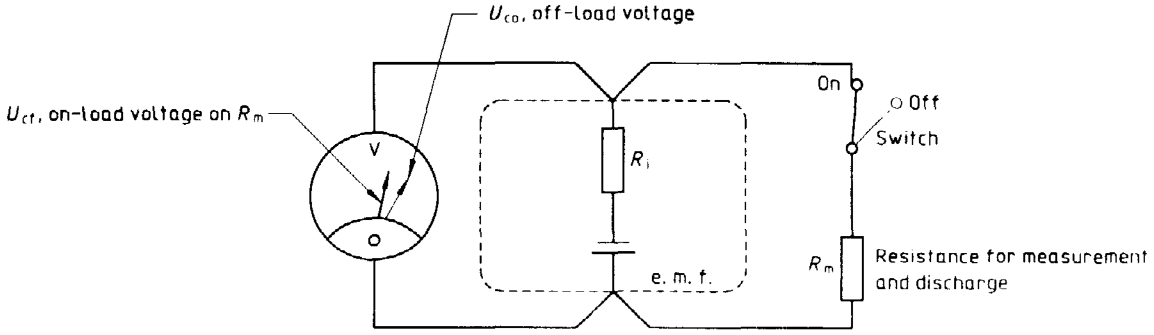

U_{co}, off-load voltage
U_{cf}, on-load voltage on R_m
V
O
R_i
e. m. f.
On
Off
Switch
R_m
Resistance for measurement and discharge

Figure 5 — Circuit illustrating principles

Table 5 — Test method for measurement of U_{cf}

Test method	PW batteries [1]		All other batteries	
	R_m Ω	t	R_m Ω	t
A [2]	(150 ± 0,5) %	1 s ± 5 %	(1 500 ± 0,5) %	10 ms ± 5 %
B [3]	(150 ± 0,5) %	0,5 s to 2 s	(470 ± 0,5) %	0,5 s to 2 s
C [4]	(200 ± 0,5) %	5 s ± 5 %	(2 000 ± 0,5) %	7,8 ms ± 5 %

1) Application with high peak current.

2) Method A (recommended test): requires specialized test equipment.

3) Method B: to be used in absence of method A test equipment.

4) Method C: to be used only by agreement between the manufacturer and customer.

NOTE — R_m shall take into consideration the resistance of the connection lines of the battery being tested and the contact resistance of the switch.

8.3.5 Calculation of internal resistance R_i

The internal resistance may determined:

— either by calculation

$$R_i = \frac{U_{co} - U_{cf}}{U_{cf}/R_m}$$

where the relation U_{cf}/R_m corresponds to the current delivered through the discharge resistance R_m (see 8.3.4);

— and/or by an LCR meter.

The value of the internal resistance shall be agreed by the manufacturer and customer.

8.3.6 Measurement of capacity

There are two methods for measuring capacity:

a) the recommended method is method A, which is more indicative of watch requirements;

b) method B is a more general method which is specified in IEC 86-1 and IEC 86-2.

When presenting capacity data, the manufacturer shall specify which test method was used.

8.3.6.1 Method A

8.3.6.1.1 Circuit

The principles of the circuit are shown in figure 6.

8.3.6.1.2 Procedure

The duration of the test is the duration of the discharge into resistor R_d, which is approximately 30 days.

The value of the resistance R_d is the value of the resistive load (specified in table 7) which shall include all parts of the external circuit and shall be accurate to within ± 0,5 %.

8.3.6.1.3 Determination of capacity

The measurements of the off-load voltage, U'_{co}, and that of the on-load voltage, U_{cf}, are carried out at least once a day on the battery permanently connected to R_d, until the first passage of U_{cf} under the endpoint voltage defined in table 4 is obtained.

a) First measurement: U'_{co}: the resistance R_d is much higher than R_m, U'_{co} approximates to U_{co}. The switch is left open while the measurement is carried out.

b) Next measurement: U_{cf}: the battery being tested is connected to R_m. The switch is left closed for a time t in accordance with table 6.

NOTE 3 The values of the measurement load, R_m, and the discharge load, R_d (which include all parts of the external circuit) should be as specified in tables 6 and 7.

c) Calculation of capacity C: the capacity of the battery is obtained by adding the partial capacity amounts C_p, calculated after each measurement with the following formula:

$$C = \Sigma C_p$$

$$C_p = \frac{U'_{co} \times t_i}{R_d}$$

where t_i is the time between two measurements.

NOTE 4 At the end of the discharge, it is recommended that several measurements be carried out each day in order to obtain sufficient accuracy.

8.3.6.2 Method B

8.3.6.2.1 Circuit

The principles of the circuit are shown in figure 7.

8.3.6.2.2 Procedure

See 8.3.6.1.2.

8.3.6.2.3 Determination of capacity

When the on-load voltage of the battery under test drops for the first time below the endpoint specified in table 4, the time t is calculated and defined as the discharge duration time.

The capacity C is calculated by the following formula:

$$C = \frac{\overline{U}_{cf}}{R_d} \times t$$

where

$\overline{U}_{cf}$ is the average value of the voltage of U_{cf} during the discharge duration time t;

t is the discharge duration time.

Table 6 — Method A for measurement of U_{cf}

Batteries with KOH electrolyte		All other batteries	
R_m Ω	t	R_m Ω	t
(150 ± 0,5) %	1 s ± 5 %	(1 500 ± 0,5) %	10 ms ± 5 %

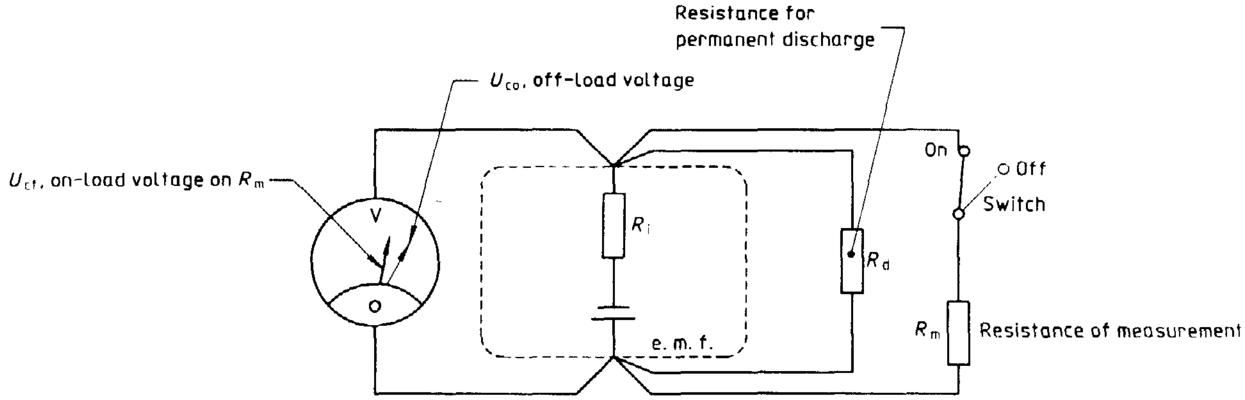

Resistance for permanent discharge
U_{co}, off-load voltage
U_{cf}, on-load voltage on R_m
V
O
R_i
e. m. f.
R_d
On
Off
Switch
R_m
Resistance of measurement

Figure 6 — Circuit illustrating principles for method A

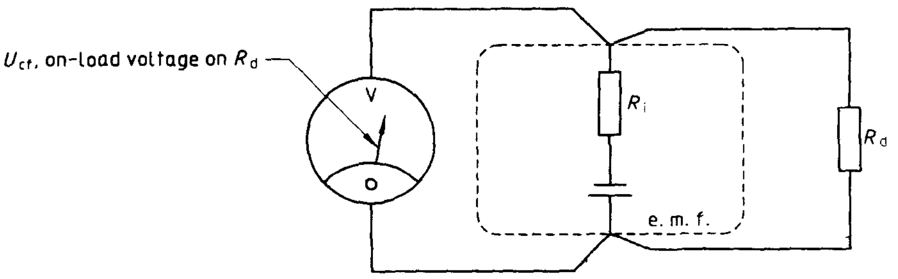


Figure 7 — Circuit illustrating principles for method B

8.3.7 Calculation of the internal resistance R_i during discharge in the case of method A (optional)

After each measurement of U'_{co} and U_{cf} is carried out in accordance with the procedure described in 8.3.6, it is possible to calculate the internal resistance R_i of the battery using the following formula:

$$R_i = \frac{U'_{co} - U_{cf}}{U_{cf}/R_m}$$

8.4 Capacity retention

The capacity retention is the ratio between the capacities under the given discharge conditions measured on fresh batteries and a sampling of the same lot stored for 365 days at 20 °C ± 2 °C at a relative humidity between 45 % and 70 %.

The ratio of capacity retention shall be agreed between the manufacturer and customer. The minimum value should be at least 90 % for a period of 12 months.

The capacity measurement is carried out in accordance with the procedure described in 8.3.6.

Table 7 — Discharge resistance

Letter code for electrochemical systems	L	S	G	Letter code for electrochemical systems	C	B
Code number according to dimensions	**Discharge resistance, R_d kΩ**			**Code number according to dimensions**	**Discharge resistance, R_d kΩ**	
510				1212		
512						
514				1216		
516		150				
521		100		1220	62	
527		68				
610				1225		
612						
614		120		1612		
616		100				
621		68		1616		
626		47				
710				1620	47	
712		100				
714		68		1625		

Letter code for electrochemical systems	**L**	**S**	**G**	**Letter code for electrochemical systems**	**C**	**B**
Code number according to dimensions	**Discharge resistance, R_d** kΩ			**Code number according to dimensions**	**Discharge resistance, R_d** kΩ	
716		68				
721		47		2012		
726		33				
731		27		2016	30	
736		22				
754		15		2020	30	
910						
912				2025	15	
914						
916		47		2312		
920		33				
927		22		2316		
936		15				
1110				2320	15	
1112						
1114				2325		
1116		39				
1120		22		2412		
1126		15				
1130		15		2416		
1136		15				
1142		10		2420	15	
1154		6,8				
				2425	15	
NOTE — Blank values are under consideration.						

8.5 Test method for determining the resistance to leakage

8.5.1 Preconditioning and preliminary examination

Before carrying out the tests specified in 8.5.2 and 8.5.3, the batteries shall be submitted to a visual examination in accordance with the requirements stated in clause 9.

For the tests specified in 8.5.2.1 and 8.5.2.2, batteries shall be preconditioned at the specified temperature (40 °C and 45 °C respectively) for 2 h to avoid condensation at elevated humidity.

8.5.2 Humid heat test

8.5.2.1 Recommended test

The battery shall be stored under the conditions specified in table 8.

Table 8 — Storage conditions for recommended test

Temperature °C	Relative humidity %	Test time days
40 ± 2	90 to 95	30 or 90
NOTE — The test time of 30 days may be used for an accelerated routine quality control test, whereas the test time of 90 days applies to qualification testing of new batteries.		

8.5.2.2 Optional test

After agreement between the manufacturer and customer, the test conditions specified in table 9 may be chosen.

Table 9 — Storage conditions for optional test

Temperature °C	Relative humidity %	Test time days
45 ± 2	90 to 95	20 or 60
NOTE — The test time of 20 days may be used for an accelerated routine quality control test, whereas the test time of 60 days applies to qualification testing of new batteries.		

8.5.3 Test by temperature cycles

The battery shall be submitted to 150 temperature cycles in accordance with the schedule shown in figure 8.

The relative humidity shall be 50 % to 60 % at room temperature; it will subsequently vary with the temperature variation.

9 Visual examination and acceptance conditions

9.1 Preconditioning

Before carrying out the preliminary visual examination or after the tests specified in clause 8, the batteries shall be stored for at least 24 h at room temperature and at a relative humidity between 45 % and 70 %.

NOTES

5 The leakage should, as a rule, be observed after crystallization of the electrolyte. The storage time of 24 h can be prolonged if necessary.

6 This examination may be applied to new or used batteries, or to batteries which have been submitted to different tests.

9.2 Magnification

The visual examination shall be carried out at a magnification of × 10 to × 15. The magnification of × 15 is necessary in order to detect small leaks.

9.3 Lighting

The visual examination shall be carried out under a diffuse white light of 900 Lx to 1 100 Lx at the surface of the battery to be inspected.

9.4 Leakage levels and classification

The leakage levels and the classification are given in table 10.

9.5 Acceptance conditions

The acceptable level, as well as the proportion of defective pieces, shall be by agreement between the manufacturer and customer.

Fresh batteries with a level of leakage exceeding S1, shall not be submitted for qualification.

The acceptance criteria may be less restrictive for batteries which have been tested in accordance with the procedure specified in 8.5.2.

If necessary, photographic references may be established.

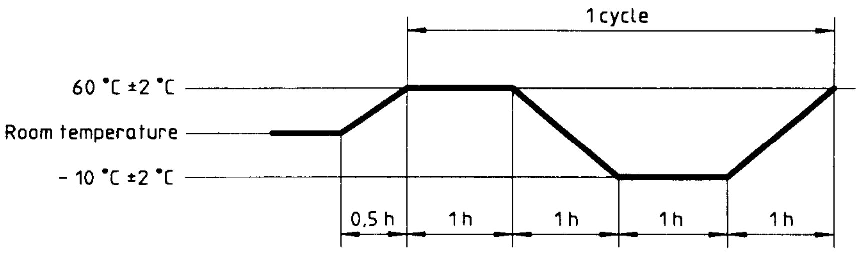


Figure 8 — Test by temperature cycles

Table 10 — Leakage levels and classification

Leakage levels		Definition
Classification	**Grade**	
Salting	S1	Small leaks found near the gasket, affecting less than 10 % of the perimeter of the gasket, detected while observing at a magnification of × 15. The leak is not detectable with the naked eye.
	S2	Slight traces of leaks near the gasket, detected with the naked eye. At a magnification of × 15, it may be noted that these leaks affect more than 10 % of the perimeter of the gasket.
	S3	Leaks spreading in clouds on both sides of the gasket, detected with the naked eye, but not reaching the flat negative contact.
Clouds	C1	Leaks spreading in clouds on both sides of the gasket, but not reaching the central part of the flat negative contact.
	C2	Leaks spreading in clouds, reaching the central part of the flat negative contact.
Leaks	L1	The accumulation of crystallized liquid coming from the electrolyte swells up on part of the cloud spread, which covers the entire surface of the flat negative contact.
	L2	The accumulation of crystallized liquid coming from the electrolyte swells up on the entire cloud spread, which covers the entire surface of the flat negative contact.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publication), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards Monthly Additions'.

This Indian Standard has been developed from Doc: No. LM 23 (0178).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 323 01 31, 323 33 75, 323 94 02

Telegrams: Manaksanstha
(Common to all offices)

Regional Offices:

		Telephone
Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	323 76 17, 323 38 41
Eastern	: 1/14 C.I.T. Scheme VII M, V.I.P. Road, Maniktola CALCUTTA 700054	337 84 99, 337 85 61 337 86 26, 337 91 20
Northern	: SCO 335-336, Sector 34-A, CHANDIGARH 160022	60 38 43 60 20 25
Southern	: C.I.T. Campus, IV Cross Road, CHENNAI 600113	235 02 16, 235 04 42 235 15 19, 235 23 15
Western	: Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400093	832 92 95, 832 78 58 832 78 91, 832 78 92

Branches : AHMADABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. PATNA. PUNE. THIRUVANANTHAPURAM.

Printed at Dee Kay Printers, New Delhi, India